CLAIMS

What is claimed is:

1. A method for creating semiconductor devices, comprising:

providing a photoresist layer on a wafer;

5 patterning the photoresist layer;

chemically cross-linking polymers in the patterned photoresist layer by exposure to at least one reactive chemical; and

transferring the pattern in the photoresist layer.

2. The method, as recited in claim 1, wherein the chemically cross-linking polymers, comprises exposing the patterned photoresist layer to a reactive gas.

3. The method, as recited in claim 2, wherein the patterning the photoresist layer comprises exposing the photoresist layer with a light that has a wavelength that is less than 248 nm.

4. The method, as recited in claim 2, wherein the patterning the photoresist layer comprises exposing the photoresist layer with a light that has a wavelength no greater than 193 nm.

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5. The method, as recited in claim 4, wherein the chemically cross-linking polymers, further comprises heating the wafer.

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- 6. The method, as recited in claim 5, wherein transferring the pattern comprises etching the wafer.
- 7. The method, as recited in claim 5, wherein the transferring the pattern comprises implanting ions into the wafer.
 - 8. The method, as recited in claim 2, wherein at least the top 10% of volume of the photoresist layer is cross-linked.
- 10 9. The method, as recited in claim 2, wherein the chemical cross-linking improves photoresist etch selectivity without shrinkage.
- The method, as recited in claim 2, wherein the photoresist layer is a photoresist material selected from the group comprising of Poly(methyl methacrylate) derivatives
 and Cycloolefin Maleic Anhydride derivatives.
 - 11. A method for creating semiconductor devices, comprising:

 providing a photoresist layer on a wafer;

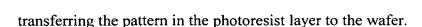
 patterning the photoresist layer, comprising:
- exposing regions of the photoresist layer with a light with a wavelength no greater than 193 nm; and

removing regions of the photoresist layer;

cross-linking polymers in the patterned photoresist layer; and

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- 12. The method, as recited in claim 11, wherein the photoresist layer is a photoresist material selected from the group comprising of Poly(methyl methacrylate) derivatives and Cycloolefin Maleic Anhydride derivatives.
 - 13. A method for creating semiconductor devices, comprising: providing a photoresist layer on a wafer;

patterning the photoresist layer;

exposing regions of the photoresist layer with a light with a wavelength no greater than 193 nm; and

removing regions of the photoresist layer;

heating the wafer

chemically cross-linking polymers in the patterned photoresist layer by
exposing the patterned photoresist layer to a reactive gas; and
etching the pattern in the photoresist layer into the wafer.

14. A semiconductor device created by the method comprising:

providing a photoresist layer on a wafer;

20 patterning the photoresist layer;

chemically cross-linking polymers in the patterned photoresist layer by exposure to at least one reactive chemical; and

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- 15. The semiconductor device, as recited in claim 14, wherein the chemically cross-linking polymers, comprises exposing the patterned photoresist layer to a reactive gas.
- 16. The semiconductor device, as recited in claim 14, wherein the patterning the photoresist layer comprises exposing the photoresist layer with a light that has a wavelength that is less than 248 nm.
- 17. A reaction chamber for processing a wafer with a patterned layer of photoresist material, comprising:
 - a chamber with a central cavity;
 - a wafer support for supporting the wafer in the central cavity; and
- a cross-linking reactive chemical source in fluid contact with the chamber and which provides a reactive chemical which causes cross-linking of the photoresist.
 - 18. The reaction chamber, as recited in claim 17, further comprising:

 a wafer heater in thermal contact with the wafer support; and

 a device for regulating the pressure in the chamber.
 - 19. The reactor chamber, as recited in claim 18, further comprising a control system, comprising computer readable media, comprising:

computer readable code controlling the device for regulating pressure in the chamber;

computer readable code for instructing the wafer heater to heat the wafer to an operational temperature; and

computer readable code for instructing the reactive chemical source to provide reactive chemical to the chamber cavity to expose the wafer to the reactive chemical.